Naval Ocean Systems Center
San Diego, CA 92152-5000

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Signal Processing Device to Control Microwave Output

San Diego State University Foundation

NAVAL OCEAN SYSTEMS CENTER

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The development of an electronic device to control the operation of a commercial microwave oven is discussed. This device, when installed in conjunction with the existing circuitry of SHARP MICROWAVE OVEN (model R-9524), is capable of automatically advancing through a sequence of thawing recipes programmed and stored in the memory bank of the oven. The device therefore eliminates or minimizes human operator action needed in previous prototype versions of a blood-thawing device.

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ABSTRACT

The development of an electronic device to control the operation of a commercial microwave oven is discussed. This device when installed in conjunction with the existing circuitry of SHARP MICROWAVE OVEN (model R-9524) is capable of automatically advancing through a sequence of thawing recipies programmed and stored in the memory bank of the oven. The device therefore eliminates or minimizes human operator action needed in previous prototype version of a blood thawing device.

INTRODUCTION AND BACKGROUND

In today's society where progress in Medical Science has facilitated advancement in health care, there is increasing need for readily available biological tissues for transplantation. In the armed services, this need can be critical during times of confrontation and war. Presently, cryopreserved tissues such as blood are thawed upon need using a warm water bath. This method requires a water bath, heating element, pumps, filter and such other ancillary equipment which makes it cumbersome. Additionally, this may require transportation of clean water to far away territories to ensure safe, uncontaminated thawing. Over the last several years the U. S. Navy has supported research and development of an alternate method for thawing frozen blood components. Under that support this investigator had developed a working prototype to thaw frozen blood in bulk quantities using modified commercial microwave ovens. The evaluation tests conducted at NBRL-Boston demonstrated the success of this method. The thawed units although, were judged to be excellent from percent recovery and biochemical standpoints, concern was raised by the user (NBRL) over the lack of "user friendliness" of the system. Specifically, the operation of the system needed continued operation action and supervision. This was unacceptable for large-scale clinical usage intended by the Navy. Development of an electronic controller was therefore undertaken under the present contract. A control device was developed fabricated, tested and delivered to the Naval Blood Research

Laboratory (NSFL) Boston in September 1987 via the Naval Ocean Systems Center (NOSC) in San Diego.

DISCUSSION

The model R-9524 SHARP microwave oven is equipped with an auto-touch control panel shown in figure 1. The touch panel is hard wired to a proprietary micro processor (LSI-1x2129YA). The oven operation is controlled by touching appropriate pads arranged on the surface of the control panel. A lighted digital readout displays cooking time, temperature, memory sequence etc. during the operation of the oven.

As seen from figure 1, the memory bank has three memories (numbered Memory 1, 2 and 3). Each memory can be accessed independently and only through operator action. Each memory can be programmed to contain a maximum of three numerical settings corresponding to a temperature or time of cooking at a desired power level (high, medium high, medium, medium low or hold). Upon initiating the cooking sequence (started by touching COOK pad), the oven sequences through the numerical settings and performs the cooking operations within the memory. The oven stops after sequencing through a memory. Since the three memory banks are independent, the oven is not capable of accessing cooking instructions stored in subsequent memory banks without operator action. For example if the operator initiates cooking in Memory 1, the oven cannot access instructions in Memory 2 or Memory 3. Consequently, the oven stops at the conclusion of Memory 1.

This feature caused difficulty in thawing frozen blood. A safe blood thawing protocol calls for a recipe containing 7 to 9 numerical settings requiring all three memory banks. This meant that the use of Sharp Model R-9524 necessitated constant operator action to push COOK pad at the conclusion of instructions in each memory. To circumvent this difficulty an electronic controller was devised. This device facilitated accessing all three memories automatically without operator action.

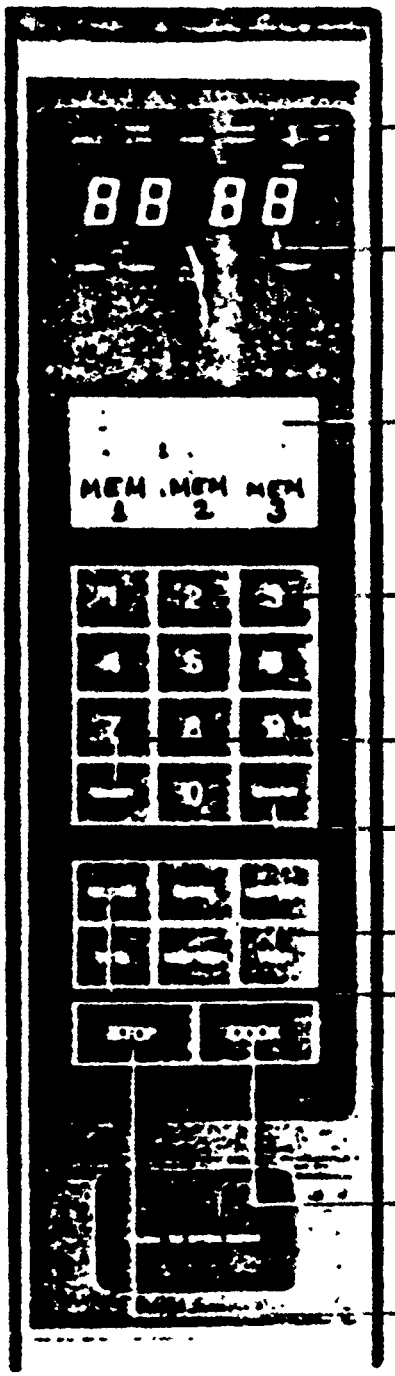
THE AUTO CONTROLLER

The controller is schematized in fig. 2. It is designed to be operated in conjunction with the existing control circuitry of the oven. In principle it is a switch that activates the "next" memory upon completion of instructions in the "present" memory.

The device is activated by the audible signal given-out by the oven controller at the end of each memory sequence. The circuitry distinguishes this audio signal from other audio signals and produces a signal similar (in shape and size) to the one produced by pushing "COOK" pad. This signal then activates the relay controlling the power-on that depends on the activation of Memory 2 or Memory 3. Thus automatic accessing of the instructions contained in Memories 1 - 3 becomes possible.

The circuitry shown in fig. 2 was fabricated on a standard proto-board and installed in two microwave ovens supplied by NOSC. The successful operation of the oven using this controller was tested and demonstrated to NBRL personnel during September 1987. The ovens are presently in operation at NOSC, San Diego and NBRL Boston.

AUTO-TOUCH™ PANEL



DISPLAY WINDOW
Indicator lights for hold, variable cooking, cook, memory, auto start and temp

LIGHTED DIGITAL DISPLAY
Shows readout of cooking time, temperature or time of day

PROGRAM SELECTOR
Touch for memory entry, auto start, temperature or memory recall

NUMBER PADS
Touch to enter cooking times, temperature settings or clock time

TIMER PAD
Touch to set minute timer

CLEAR PAD
Touch to erase cooking program

VARIABLE COOKING CONTROL PADS
Touch to select power setting. If not touched, HIGH is automatically selected.

CLOCK
Touch to set clock

COOK PAD
Touch to start oven

STOP PAD
Touch to stop operation of oven during cooking

Figure 1. Auto-Touch Panel of Sharp Microwave Oven Model R-9524.

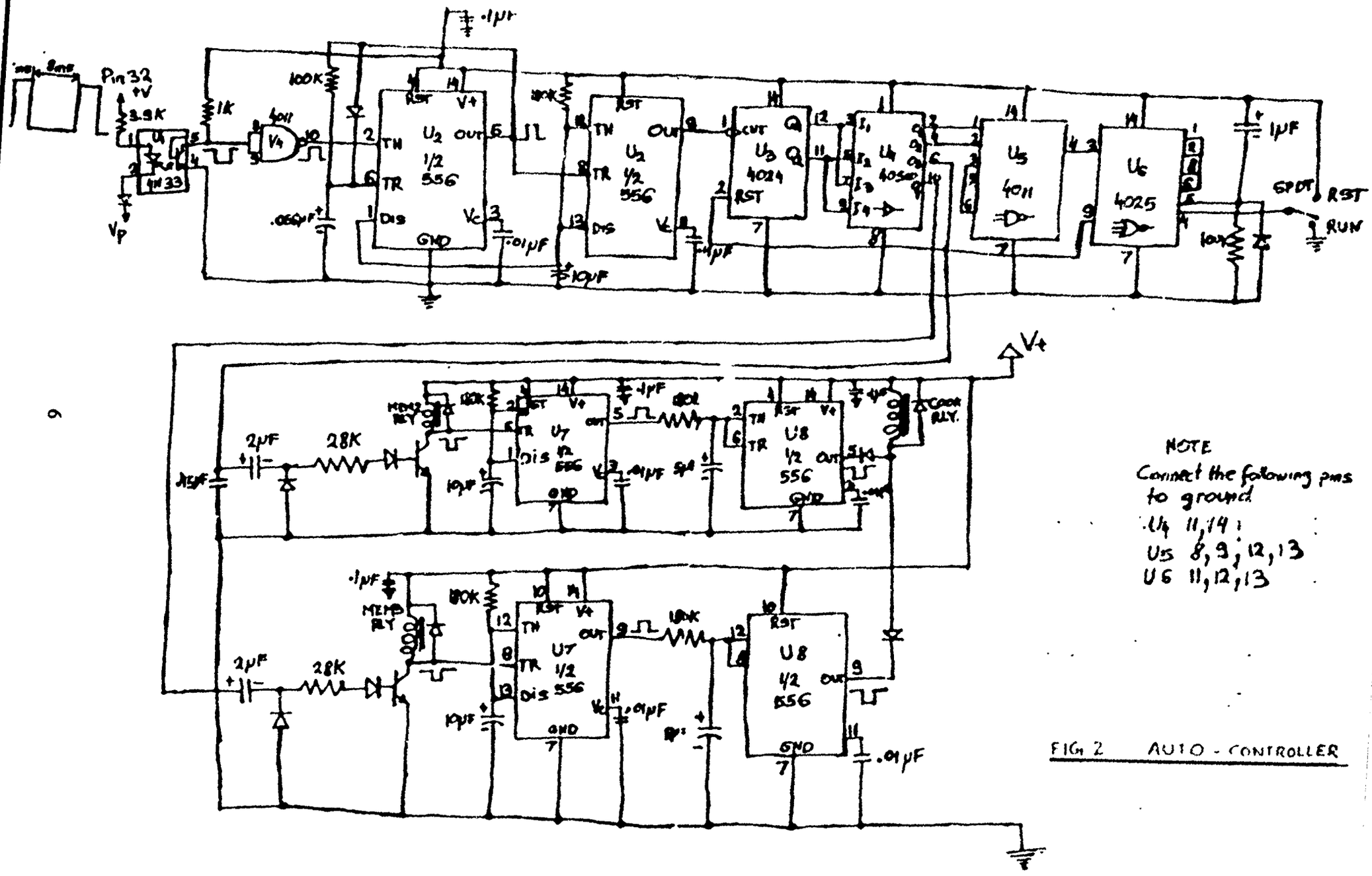


FIG 2 AUTO - CONTROLLER

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